

THE U.S. FISH AND WILDLIFE SERVICE (USFWS) began reintroducing the endangered gray wolf to the Greater Yellowstone Area (GYA) and central Idaho in 1995. The restoration of wolves to the GYA has become one of the most successful wildlife conservation programs in the history of endangered species conservation. Yellowstone is now considered one of the best places in the world to watch wild wolves. The visibility of wolves within the park and public interest in wolves and wolf-based education programs have far exceeded initial expectations. But questions have persisted about the economic impact of wolf restoration that we have sought to answer.

During preparation of the Environmental Impact Statement (EIS) that was completed by the National Park Service prior to wolf restoration (USFWS 1994), one of the main concerns of wolf-reintroduction opponents was the expenditure of public federal funds for the restoration effort and the potential for negative effects on the regional economy. These assumed negative effects included the costs of wolf depredation on livestock and reduced big game populations resulting in lower economic returns to agencies and businesses that derive revenue from big game hunting. Proponents, on the other hand, predicted increased regional visitation and positive regional economic impacts as a result of wolf restoration.

Based on a 1991 park visitor survey, wolf recovery in Yellowstone was predicted to have a positive impact of \$19 million annually in the regional economy due to increased wolf-related visitation to the park. If true, that would more than offset the negative economic impacts on the livestock industry and big game hunting that were expected to result from wolf restoration.

To test the economic projections that were made as part of the EIS analysis, in 2005 we surveyed park visitors about their expenditures and reasons for visiting the park. This paper focuses on two primary results from the 2005 survey: preferences for wildlife viewing among Yellowstone visitors and the regional economic impacts attributable to wolf presence in the park.

Data Collection

The Yellowstone National Park 2005 Visitor Survey was designed to collect a broad spectrum of information and opinions from park visitors. For purposes of the regional economic analysis, information was collected on visitor attitudes toward wolf recovery and wildlife and on visitor expenditures. From spring through fall, visitors at all five park entrance stations were asked to participate in the survey. Winter visitors traveling by car were contacted at the North Entrance. A separate sample of visitors was contacted at parking areas in the Lamar Valley where people specifically interested in seeing wolves tend to congregate. Because the Lamar Valley sample is not representative of park visitors as a whole, their survey responses are not included in the data represented here unless otherwise stated.



A total of 2,992 surveys were distributed from December 2004 to February 2006; 1,943 were completed and returned for an overall response rate of 66.4%: 1,431 from the park entrance sample (64.4% response rate) and 521 from the Lamar sample (74.2%). The resulting responses were weighted appropriately to reflect the actual distribution of 2005 park visitation by entrance and season. The survey procedure followed a standard Dillman (2000) mail survey methodology using initial contact and repeat follow-ups.

Visitor Wildlife Viewing Preferences

Visitors were asked to list the three animals from a list of 16 that they would most like to see while in the park (Table 1 compares the 2005 study results from summer visitors to

Wolf Recovery in Yellowstone

Park Visitor Attitudes, Expenditures, and Economic Impacts

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Wolf watchers at Slough Creek,
photograph by Jim Peaco/NPS.

similar surveys conducted in 1991 and 1999). The “charismatic megafauna,” including large carnivores and ungulates, rank highest on the lists. The large carnivores are consistently among the top five ranked species. In the 1991 study, wolves ranked ninth in popularity; 15% of park visitors listed them as one of the three species they would most like to see even though wolves were not present in the park. In the 1999 study, following wolf reintroduction, wolves were ranked second after grizzly bears and the percentage of visitors who chose wolves had increased to 36%. In the 2005 study, 44% of visitors listed wolves as a species they would most like to see, again ranking it second after grizzlies.

When asked to indicate which species they saw on their trip to the park, nearly all respondents reported seeing bison (93% to 98%), and a large share reported seeing elk (85% to

92%). As expected, very few visitors (1.8% or less) reported seeing the rarely viewed mountain lion and wolverine. Table 2 shows the percentage of entrance sample respondents who reported seeing wolves, coyotes, and both wolves and coyotes. For purposes of analyzing the impact of wolf presence in Yellowstone, we reduced the chance of counting visitors who misidentified coyotes as wolves by using the percentage of visitors who reported seeing both coyotes and wolves.

Table 2 shows that, depending on the season (spring, summer, or fall) from 9% to 19% of visitors reported seeing both wolves and coyotes. In winter, about 37% of North Entrance visitors reported seeing wolves and coyotes. Applying these percentages to the actual 2005 recreational visitation levels yields an estimate of 326,000 visitors who saw wolves in 2005. Although this is a conservative estimate because it excludes

winter visitors who came through the West, East, and South entrances on over-snow vehicles, it is substantially higher than previous estimates. For example, according to field counts of wolf-watching visitors by Yellowstone National Park personnel (Smith 2005), about 20,000 visitors per year were viewing wolves. Given the size of the park, the widespread distribution of wolves (Smith 2005), and the limited presence of park personnel in the field, this method may have under-estimated the number of wolf observers by more than an order of magnitude.

Yellowstone Visitor Trip Expenditures

A key measure of the economic significance of a resource such as Yellowstone to the local economy is the amount of money visitors from outside the three-state area of Montana, Idaho, and Wyoming spend during their trips. To obtain an estimate of this, the survey questionnaire asked visitors to indicate the total amount they spent on their trip, as well as the amount they spent in these three states. Table 3 compares the reported average trip spending by season for residents of the three states to the spending of nonresidents.

Net Recreation Impacts of Wolf Recovery on the Regional Economy

Survey respondents were also asked if the possibility of seeing or hearing wolves had been a reason for their visiting

the park and, if so, whether they would have come if wolves had not been present. Based on the responses to this question by both residents and nonresidents we estimated that the percentage of annual Yellowstone visitation attributable to wolves is 3.7%, ranging from 1.5% in the spring to nearly 5% in the fall. The percent for nonresidents only is similar, ranging from around 2% of spring visitors to almost 5% of summer visitors (Table 4). Table 4 shows the derivation of our estimate of the economic impact to the three-state region.

We estimate that approximately 94,000 visitors from outside the three-state region came to the park specifically to see or hear wolves in 2005, and that they spent an average of \$375 per person, or a total of \$35.5 million in the three states (Table 4). Prior to reintroduction, Duffield (1992) estimated that a recovered wolf population would lead to increased visitation from outside the three-state region resulting in an additional \$19.35 million in direct visitor spending in the three states. Adjusted for inflation this would be \$27.74 million per year in 2005—less than the \$35.5 million estimate based on the data from our 2005 study, but well within the 95% confidence interval (\$22.4 to \$48.6 million).

Wolf Impacts on Livestock and Big Game Hunting

The EIS economic analysis provided estimates of the impacts of a recovered wolf population on livestock predation and big game populations in the three-state area. The estimated

| Rank | 1991 Study | | 1999 Summer Study | | 2005 Summer Study | |
|------|------------|-------|-------------------|------|-------------------|------|
| | Species | % | Species | % | Species | % |
| 1 | Grizzly | 0.550 | Grizzly | 0.58 | Grizzly | 0.55 |
| 2 | Black Bear | 0.332 | Wolf | 0.36 | Wolf | 0.44 |
| 3 | Moose | 0.332 | Moose | 0.35 | Moose | 0.41 |
| 4 | Elk | 0.239 | Lion | 0.31 | Black Bear | 0.26 |
| 5 | Lion | 0.229 | Black Bear | 0.29 | Lion | 0.25 |
| 6 | Sheep | 0.219 | Sheep | 0.23 | Sheep | 0.21 |
| 7 | Eagle | 0.187 | Eagle | 0.21 | Eagle | 0.21 |
| 8 | Bison | 0.160 | Bison | 0.19 | Bison | 0.21 |
| 9 | Wolf | 0.154 | Elk | 0.14 | Elk | 0.14 |
| 10 | Wolverine | 0.047 | Wolverine | 0.06 | Wolverine | 0.06 |

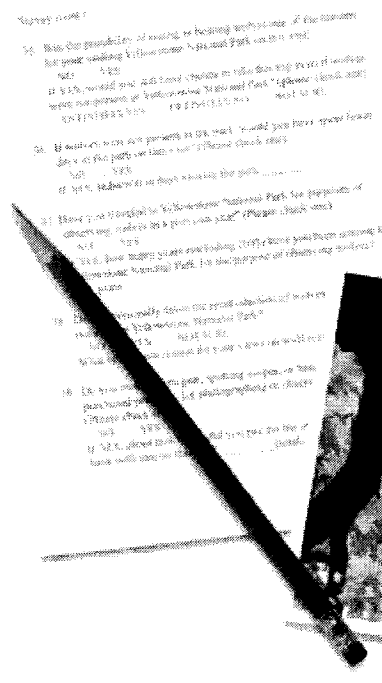
The 2005 study also included six other species that were selected as preferred by some respondents: trumpeter swan (3%), deer (2%), fox (1.8%), coyote (0.6%), antelope (0.3%), and goose (0.1%).

Table 1. Comparison of Yellowstone National Park visitor ratings of the animals they most would like to see on their trips to Yellowstone.

livestock losses of \$1,900 to \$30,500 per year (mostly for cattle and sheep) were based on assumptions of a recovered population of 100 wolves. During the period when wolf numbers were near 100 (1997–2000), annual losses averaged \$11,300 (based on actual payments at market prices for wolf kills verified by Defenders of Wildlife, www.defenders.org). When wolves numbered more than 300 in 2004 and 2005, losses averaged \$63,818 per year, twice the high-end estimate predicted in the EIS. Even if payments by Defenders of Wildlife understated livestock losses by a factor of two due to the difficulty of verifying all actual kills, recent direct losses would still be less than \$130,000 per year. Other livestock industry costs resulting from wolf reintroduction have not been quantified, but could include increased fencing and management costs associated with reducing wolf predation on a given ranch.

Based on biologists' projections of the impact of wolf predation on big game populations, the EIS projected a decline of 2,439 to 6,157 hunter days for elk, deer, and moose on the northern range and for Jackson and North Fork Shoshone elk. The associated foregone annual hunter expenditure was projected to be \$207,000 to \$538,000, based on approximately \$85 hunter expenditure per day for those species. In 2005 dollars, this would be a loss of \$342,000 to \$890,000. Three of the species examined in the EIS (deer, moose, and bison) either have seen no reduction in population levels (as was predicted in the EIS) or, in the case of moose, have inadequate data to evaluate current population levels (White et al 2005). There have been no reductions for permits, animals harvested, or hunter success for mule deer or moose on the northern range as a result of wolf restoration (White et al. 2005).

The other key game species, elk, has provoked substantial concern in recent years because some herd sizes have dropped dramatically as wolf numbers have risen. While a substantial body of recent literature on wolf-prey modeling in the Yellowstone ecosystem exists, most of it focuses on the northern range elk. A review of the wildlife biology literature on the northern



Left, sample page from the 1991 survey; below, Female wolf pup #17 of the Rose Creek pack in Rose Creek pen, Barry O'Neill, 1995.

range elk population shows a divergence of views on the extent to which wolf predation has been responsible for its decline. However, two peer-reviewed papers (Varley and Boyce 2006, Vucetich et al. 2005) show that the impact of wolves on elk numbers has been consistent with or below the EIS prediction, which was for a long-range reduction of 5% to 30% in the hunter elk harvest. If one accepts the Varley and Boyce (2006) estimates, which also include impacts on the Jackson and North Fork Shoshone elk herds, actual declines in big game populations as a result of wolf predation and associated hunter impact are in the range predicted by the EIS (\$342,000 to \$890,000 in 2005 dollars). A caveat to these estimates is that they do not account for substitution behavior in response to changes in elk hunting opportunities in the GYA. This may result in an overstatement of hunter impacts. It was assumed in

| Statistic | Spring N=495 | Summer N=477 | Fall N=322 | Winter N=221 |
|--|--|-----------------|---------------|-----------------|
| % Report seeing wolves | 25.4% | 15.2% | 18.5% | 42.4% |
| % Report seeing coyotes | 45.3% | 38.9% | 40.4% | 71.2% |
| % Report seeing both | 19.2% | 9.1% | 12.8% | 36.7% |
| Recreational visitation (2005) | 382,598 | 1,819,798 | 547,777 | 43,933 |
| Number of visitors seeing wolves and coyotes | 73,382 | 166,330 | 70,335 | 16,123 |
| Total estimated visitors sighting wolves and coyotes (spring-fall) | 310,046 (95% C.I. 257,210 to 362,882) | | | |
| Total estimated visitors sighting wolves and coyotes (year-round) | 326,170 (95% C.I. 273,277 to 379,097) | | | |
| Note: winter estimate includes only North Entrance visitation. | | | | |

Table 2. Estimated number of Yellowstone visitors seeing wolves and coyotes in the park in 2005.

| Season/residency | Average amount spent in ID, MT, WY | Average total trip spending | Sample Size |
|-------------------------|------------------------------------|-----------------------------|-------------|
| Spring-nonresident | \$361.89 | \$795.14 | 260 |
| Spring-3-state resident | \$86.19 | \$112.37 | 101 |
| Summer-nonresident | \$369.12 | \$757.31 | 291 |
| Summer-3-state resident | \$142.06 | \$142.06 | 45 |
| Fall-nonresident | \$425.50 | \$855.00 | 149 |
| Fall-3-state resident | \$152.67 | \$198.64 | 72 |

Note: winter results are only representative of wheeled access and are not presented.

Table 3. Comparison of park visitor spending in Idaho, Montana, and Wyoming by season and residency based on visitors responding to 2005 entrance station surveys.

the EIS that hunters who did not receive an elk hunting permit in the GYA would not hunt elsewhere in the three-state area for elk or increase hunting effort on other species.

Conclusions

Overall, it appears that the economic predictions made in the 1994 EIS analysis were relatively accurate. Our estimated increase in park visitation (3.7%) due to wolf presence is lower than was predicted in the EIS (4.93%). However, the EIS prediction was based on a survey of only summer visitors; our 2005 study estimated a 4.78% increase in summer visitation due to wolf presence. Regarding increases in visitor spending in the three-state area due to wolf presence, the estimate of \$35.5

million (confidence interval of \$22.4 to \$48.6 million) based on our 2005 study is consistent with the EIS estimate of \$27.7 million (2005 dollars).

Projected costs of wolf predation (based on the market value of cattle and sheep taken by wolves) have been in the range predicted by the EIS, and were on the order of about \$65,000 per year in 2004 and 2005. The impact of wolves on actual observed hunter harvest in the first 10 years after reintroduction was negligible, in that average hunter harvest and permits issued for big game species were either higher or unchanged compared to pre-wolf averages. However, reflecting in part the influence of a long-term drought, the presence of wolves, and aggressive management policies to reduce elk populations through hunting on the Northern Range, there

| Statistic | Spring | Summer | Fall | Winter ¹ |
|---|------------------------------|--------------|-------------|---------------------|
| Total recreational visitation to Yellowstone | 382,598 | 1,819,798 | 547,777 | 85,478 |
| % of visitors from outside the three-state area | 70.5% | 83.68% | 67.59% | 82.2% |
| (A) Recreational visitors from out of the three states | 269,770 | 1,522,807 | 370,242 | 70,289 |
| (B) % of visitors who would not have visited without the presence of wolves | 1.93% | 4.78% | 3.45% | 3.66% |
| (C) Average spending per visitor within the three states by visitors from outside the area ² | \$361.89 | \$369.12 | \$425.50 | \$510.84 |
| (A) * (B) * (C) Total estimated annual three-state visitor spending attributable to wolves ³ | \$1,885,178 | \$26,889,668 | \$5,431,916 | \$1,314,167 |
| Total estimated annual visitor spending in the three states attributable to wolves | \$35,520,929 | | | |
| 95% Confidence interval | \$22,404,274 to \$48,637,585 | | | |

¹ Based on 1999 winter visitor survey estimates (Duffield and Neher 2000).

² Average spending for those who specifically came to see wolves was nearly identical, but due to a much smaller sample size, had a much higher variance.

³ Sample size, by season for the 2005 sample was: 495 for spring, 477 for summer, and 322 for fall. The winter sample from 1998–1999 was 221.

Table 4. Estimated three-state (MT, ID, and WY) direct expenditure impact associated with wolf presence in Yellowstone National Park based on visitors responding to entrance station surveys.

has been recently a substantial reduction in elk permits. There is not a consensus among biologists on the actual impact of wolves on elk populations, but modeling supports the view that the long-term economic impact on big game hunting will be within the range projected by the EIS, of \$342,000 to \$890,000 per year (2005 dollars).

Weighing the economic impacts of increased tourism against reductions in livestock production and big game hunting participation, one can conclude that the net impact of wolf recovery is positive and on the order of \$34 million in direct expenditures. An input-output model of the three state economy (Minnesota Implan Group, 2007) can be used to estimate the effect on economic output, by accounting for indirect and induced expenditures throughout the three-state economy. Including this multiplier effect leads to an estimated total economic impact in the three-state area of about \$58 million in 2005 (range of \$34 to \$80 million).

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